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ABSTRACT

Human systems engineering (HSE) was created to introduce a new way of viewing collaboration. HSE emphasizes the role of leaders who welcome risk, commit to achieving positive change, and help others achieve change. The principles of HSE and its successful application to the collaborative process were illustrated through a case study representing a collaboration of leaders from a private-sector firm (XXsys Technologies, Inc.), the University of California at San Diego, the California Department of Transportation, and the National Institute for Standards and Technology for the purpose of applying composites for seismic retrofitting of bridge columns. The case study demonstrated that the HSE model differs from the strategic alliance model by virtue of the fact that strategic alliances focus on accomplishing a common goal whereas HSE emphasizes the recognition and achievement of individual goals for collaborating partners. The case study further established that HSE focuses on the following: individual goals rather than the common goal; maximum rather than minimum risk; the process rather than its outcomes; positive change rather than change in any form; people who do the job rather than getting the job done; and relying on the strengths of all participants rather than balancing strengths and weaknesses. (MN)

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ED 401 448

Human Systems Engineering: A Leadership Model for Collaboration and Change

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Introduction

The formation of partnerships is becoming a standard practice for leaders who wish to achieve common goals. Human Systems Engineering (HSE) was created for the purpose of introducing a new way of looking at collaboration. HSE emphasizes the role of leaders who welcome risk, commit to achieving positive change, and most important, facilitate others in achieving individual goals. Although achieving a common goal is significant to partnerships, as noted in the Strategic Alliance paradigm, Human Systems Engineering focuses on the challenge the leader faces when attempting to articulate the individual goals of the participants and how this affects the outcome of collaboration.

In order for collaboration to be successful, by way of Human Systems Engineering, certain things need to happen. The collaborating leader must facilitate in the identification of common and individual goals, promote positive chemistry between the players, and help the participants to focus on bringing about positive change. Rost (1993) defines real change and the leader's responsibility of intending change. Rost states, "Leaders and their collaborators intend real change. Intend means that the changes the leaders and their collaborators promote are purposeful" (p.99). In the Human Systems Engineering Model, the real change that occurs must be positive and included in the process as well as in the final outcome. This is not to say that material outcomes have no significance, it is just to say that Human Systems Engineering was created to pay attention to the human side of the collaborative process. Furthermore, in the absence of positive change, change occurs simply for the sake of change, and this in itself, precludes HSE.

Background

The characteristics of Human Systems Engineering were first established to describe the dynamics of a partnership initiated by Harry Featherstone, the former CEO and President of Will-Burt Company in Orville, Ohio. Featherstone spearheaded a collaboration between his manufacturing company and the University of Akron designed to increase the skills of his employees. He required all of his employees to attend courses offered by the university. The curriculum ranged from basic skills to a mini-MBA program. At the time Featherstone formed this partnership, he had been asked to take the helm of a company that was struggling to survive. He knew that a dramatic metamorphosis was needed in order for the company to regain its profitable distinction. He chose a partnership to make it happen.

Many CEOs faced with the same problem would not have taken this route. Under the guise of restructuring, they would have taken steps to downsize, and a number of workers would have lost their jobs. Not Harry. He believed, and still does, that educating employees on company time, paid for by the company, and on company property, was a good idea. Featherstone has since been recognized at the local, state, and national levels for his commitment to education in the workplace. Additionally, he has led the support for legislation that would provide tax incentives and advantages to companies such as his, that were dedicated to workplace learning.

The extent of the positive change that Featherstone engineered was more than he had expected. He found that the employees at Will-Burt were more interested in the company, less apt to be absent from work or hurt on the job, and became more involved in

the problem solving side of the manufacturing. The positive change that Featherstone engineered, in addition to the skill he exemplified in addressing the individual goals of his employees, is what inspired the development of Human Systems Engineering.

Purpose

The purpose of this paper was to introduce the Human Systems Engineering Model. A case study was presented that demonstrated an example of HSE and its successful application to the collaborative process.

The Case Study

This case study represents a collaboration of leaders from organizations representing distinct disciplines. The key players include: (1) XXsys Technologies, Inc., (XXsys), (2) the University of California San Diego (UCSD), (3) the California Department of Transportation (CALTRANS), and (4) the National Institute for Standards and Technology (NIST). In 1993, the formation began of a partnership aimed at the application of composites for seismic retrofitting of bridge columns. The risks involved were high, and the final outcomes are yet to be determined. This collaboration clearly represents an example of Human Systems Engineering in progress.

Under the leadership of Chairman and Chief Executive Officer, Gloria Ma, Ph.D., XXsys, a California based corporation, was engaged in developing and commercializing advanced materials and composite technologies originally developed for the defense and aerospace industries. Founded in 1985, it specialized in the research and development of sensor and non-destructive testing (NDT). Due to the drastic cuts in federal defense spending for sensor/NDT technology, Ma pursued the availability of United States government grant funds accessible to companies who would prove promising in their

efforts to find alternative uses for composite materials. Ma was instrumental in acquiring a $2.7 million dollar grant from NIST for the purpose of accelerating the commercialization of the composite technology for bridge column retrofitting. In order to successfully meet the objectives of the company, she formed a partnership with other agencies who would help her achieve her goal.

Ma marshaled resources and obtained support from the Federal Highway Administration (FHWA), the Advanced Research Projects Agency (ARPA), the National Institute for Standards and Technology, and the California Trade and Commerce Agency in order to validate and commercialize XXsys's carbon jacketing technology. It was obvious that in order for Ma to advance her mission, she needed to collaborate with leaders from various agencies. Along with this multi-dimentional collaboration, came individual goals for participating members as well as the common goal identified by the participating members.

During the interview with Ma, she stated, "We knew we could replace steel in the retrofitting process if we could automate the process and lower the cost. Whether or not we could adapt the technology, presented the challenge." When asked about her incentive to collaborate, Ma replied, "No one will pay more for doing the same thing than they themselves can afford to do. The calculated risk in using the University of California San Diego's paper studies proved to be a good one." Furthermore, when asked to comment on how she negotiated with other agencies and coordinated the project, she commented, "I spent a lot of time talking to people at CALTRANS. They were in need of field assurances for what we were promising in the area of seismic retrofitting with composite materials. I knew the material we were using would comply, but whether or not we could

compete, became our greatest concern." As to what gave her the courage to continue with her mission, Ma replied, "I wanted to do something that no one else had done. We wanted to take the risk and we knew the reward would be great. Besides, I have competent people."

When asked about how she felt the collaboration had affected the people participating in the program, Ma commented, "It brings people together. They need to understand one another. The trust between them must be established and there needs to exist a mutual dependency so that things can get done." She added that one of the most difficult challenges was to bring engineers from different backgrounds together. She commented that they have their own interest and way of doing things that sometimes made it difficult when it came to agreeing on how to get things done.

She added that doing good for others and pushing the frontier of knowledge forward, motivated her beyond the money to be made. Ma stressed that in the future, there needed to be a greater understanding between cultures. "In addition", she remarked, "it is important to solicit support from individuals in the local communities who could assist in moving the collaborations forward." This comment by Ma, demonstrated the dynamics of collaborations in terms of how they extend beyond original players into numerous directions. Along with additional participants, there are added individual goals that remain the focal point of making collaborations work. In regard to future aspirations, Ma stated in an interview with Owens (1996), "The market is huge. It's not even limited to the seismic retrofit market, and besides California, it includes the entire West Coast and the Pacific Rim" (p.35).

The role of the University of California San Diego, was to conduct the research needed to validate the strength of composite materials and other composite performance characteristics used in retrofitting. What UCSD had, and what XXsys needed, was the composite material and the validation testing done at the Powell Structural Resource Lab. This was required to use the Robo-Wrapper™, a machine designed by XXsys to mechanically retrofit structures. Robert Asaro, Ph.D., Professor of Engineering, who was instrumental in his contribution to the partnership, commented that UCSD had a very positive working relationship with XXSys. He referred to the underlying science, lab testing, and evaluation of material systems as crucial to the success of the collaboration. He stated, "In the old world view of technology transfer, you could not forecast how long it would take to commercially apply technology. It would take forever and a day, and by the time commercial application arrived, the technology would either be inefficient or it would break down along the way." In reference to individual goals and cooperation between partners, Asaro added, "The key to success of collaboration is the chemistry of the people and the support that each entity has for other partners. It is important that each entity involved in the collaboration makes its goal known to the others. The individual goals need to be defined so that each party can reach its goal and support other partners in reaching theirs." He added, "The goals of all the other entities are your goals too. The initial goals go far beyond what is expected as each participant becomes supportive and takes pride is the success of each partner's progress."

Asaro remarked that one of the most exciting outcomes of UCSD's collaboration with XXsys, was a plan to pursue the use of composites in the building of a small waterplane area twin hull (SWATH). This new collaborative tributary originating from

the initial partnership between XXsys and UCSD, further demonstrated the magnitude of HSE at work. The individual goal of UCSD combined with the individual goal of XXsys came together to form a new collaboration intended by design, to satisfy the individual goals of both parties.

When asked to identify the most important elements of success, Asaro remarked, "People who have a vision need to understand what the others want and need. The vision cannot be narrow. For example, the fundamental research that provides the underpinnings to support collaboration, from the university, was a university mandate." Asaro continued, "University professors are required to expand the frontier of knowledge. If a company has capital but cannot share this same commitment to expand the frontier of knowledge, then the collaboration is going nowhere. In other words, although the university goal is to expand the frontier of knowledge and the company goal is to make a profit, both parties, according to Asaro, need to maintain their own goal and support the goal of the other as well. "It is essential," he added, "for the university community to understand that companies need to make money."

An additional member of this collaboration was the California Department of Transportation (CALTRANS) who opened up the door to the use of composites for the purpose of increasing performance and competition so that the costs for retrofitting would be minimized. As a consequence, their membership in this collaboration seemed obvious as the partnership between UCSD and XXsys was attempting to do just that. Jim Roberts, the Chief of Structures at CALTANS, in an interview with Steve Loud, Editor of *Composites News*, stated, "We are finally getting what we want from vendors such as XXsys Technologies and Hexcel Fyfe in the area of quality assurance. We must replicate

in the field installations what we have seen in the labs and in the demonstrations" (Loud, 1995:3). In a later interview with Clark, Roberts remarked, "I have been instrumental in organizations and supportive of industry's advising committees and partnership teams that introduce different technical concepts. The use of composite materials in aerospace technology is focused on use, due to the cold war. All the technology developed and tested really challenges civil engineers who are used to working with concrete and metal. Concrete engineers do not understand composite engineers. They must confront the use of advanced composite materials that are stronger and weigh less, and in some cases are non- corrosive." Roberts added, "Regarding collaborative models verses independent models, our business is highways. If we do not reach out to manufacturers, then we only get input from the design side." When asked his opinion about the disadvantages verses the advantages of collaboration, Roberts said, "You get better quality from collaboration. Partnerships help to hammer out solutions. The disadvantage is that it takes longer for things to get done due to the number of parties offering their input. Plus, people like to sit and watch. We do the work from the ground up, and then others want to come along."

The federal government's role in this case study occurred by way of a grant awarded to XXsys Technologies from the National Institute of Standards and Technology (NIST). Limited by non-disclosure guidelines, Carol Schute, Ph.D., Program Manager, commented exclusively on the subject of collaboration and not on any specifics regarding the participants cited in this case study. When asked to comment on what she believed made collaboration successful, Schute remarked, "It is wonderful when it is done for the right reasons. People need to get along well, and there needs to be good chemistry between team members." "From my experience," she added, "teams who come to us who

have worked together in the past, seem to work together better. It is important for each participant to understand their goal. When asked to reflect one year later on the experience, team members should be able to tell me why they were successful, how they determined the success, as well as how it was measured." Schute commented that in order for successful collaboration to exist there needs to be a "win-win" attitude by all the players. "It is essential," she said, "that collaboration does not become just another fad, but that it is done for the right reasons. Our job is to facilitate in the collaborative process."

Schute's comments reinforced the idea that collaboration is much more than representatives, from various organizations, getting together to conduct "a mutual business deal." Schute suggested that in order for partnerships to be successful, the leaders need to be more concerned about how well they work together than on how "their" piece of the puzzle fits another piece of the puzzle. Schute referred to the leader who focuses on bringing about positive change. This is done by helping collaborating partners to simply get along.

Robert Bloks Berg-Fireovid, a business analyst from NIST stated during his interview, "If the principles have the strength to overcome the challenges of people working together from various organizations, then collaboration can be successful. This also refers to employees within their own organization who may feel chided by the attention and reliance on employees from organizations outside of their own." Bloks Berg-Fireovid referred to this as the "wounded prince theory." He mentioned that the major principles needed to learn how to ease the discomfort of the wounded princes in their organizations and bring them along in the process. He also stated that it is essential

that each participating member of the collaboration clearly establishes individual goals and make them known to others. He remarked, "It is essential for each member to get out of the collaboration what they want."

Strategic Alliance Verses Human Systems Engineering

Strategic Alliance supports the notion that there exists a common goal and that it is important for the partnership to focus on accomplishing it (Tushman & Anderson, 1986:439-465). Human Systems Engineering is different in that it emphasizes the recognition and achievement of individual goals for collaborating partners. Schute and Bloks Berg-Fireovid believed that it was paramount for participating principles to declare at the initial stage of collaboration, their individual goals and expected outcomes. Human Systems Engineering is designed to identify expected outcomes and individual goals at the onset of collaboration. In this case XXsys, UCSD, CALTRANS, and NIST, made a strong contribution to the collaborative effort. Unlike Strategic Alliance, HSE is designed to acknowledge the strength of each member of the collaboration as opposed to relying on one participant's strength and another participant's weakness.

Additionally, Strategic Alliance, is often mentioned in relationship to vertical and horizontal partnerships that represent different businesses working together for a variety of reasons including, political, economic, or technical. Furthermore, there exists a clear focus on outcomes, cost reduction, and minimizing risk (Wright, et.al., 1996:95). Human Systems Engineering supports the notion that the purpose of collaboration is more than to simply bring participants together for a common goal, to offset weaknesses with strengths, and minimizing risk.

In summary, HSE is committed to the dynamic relationship between people who choose collaboration, emphasize individual goals, and create positive change as a consequence of collaboration. It is important to identify the variables that distinguish Strategic Alliance from Human Systems Engineering. The following table was created to exemplify the difference.

Strategic Alliance	**Human Systems Engineering**
Leader focuses on common goal	Leader focuses on individual goals
Minimum risk	Maximum risk
Focus on outcomes	Focus on process
Emphasis on change	Emphasis on positive change
Focus on getting the job done	Focus on people who do the job
Balances strengths and weaknesses	Relies on strength of all participants

Further Investigation

As HSE evolves into a model that suitably addresses the dynamics of the collaborative process, the following topics should be explored, and they include:

1. The role of the leader in bringing about positive change
2. The essence of understanding HSE and its role in facilitating collaboration
3. The challenge of focusing on individual goals verses a common goal
4. The particulars of inviting risk into risk-minimizing partnerships
5. The extrapolation of the initial partnership into collaborative tributaries

Conclusion

Human Systems Engineering focuses on people. Its purpose is to draw attention to leaders who choose collaboration as a way of bringing about positive change and embracing the individual goals of the participants. HSE is a model that can be used to ensure successful collaboration.

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